OPTICAL OBSERVATION OF THE LUNAR SURFACE FROM THE ORBITER OF SELENE. Hisashi Otake[1], Jun'ichi Haruyama[1],Tsuneo Matsunaga[2], and LISM Working Group, [1]National Space Development Agency of Japan, [2]Geological Survey of Japan.

Abstract: SELENE(SELenological and ENgineering Explorer), which is the joint project of Institute of Space and Astronautical Science (ISAS) and National Space Development Agency of Japan (NASDA), is going to be launched by H-IIA rocket in 2003. In this mission, to accumulate knowledge for lunar science and to investigate the feasibility of the moon utilization in future are aimed. We, Lunar Imager/ Spectrometer (LISM) working group, have proposed three optical instruments for spectroscopic and topographic observation for this mission: Spectral Profiler (SP), Multi-band Imager (MI) and Terrain Camera (TC). The main purposes of their observations are to study (1) crustal composition and structure, (2) mantle material, (3) mare basalt volcanism, and (4) tectonic activity of the moon. SP obtains continuous spectra with high S/N ratio and accuracy to identify mineral compositions. MI has such a high spatial resolution and wide spatial coverage that can discriminate geologic units in detail for the almost entire lunar surface. When the data obtained by SP and MI are combined, detailed mineral distributions for large area will be estimated with high spatial resolution. TC obtains the global stereo image data with high spatial resolution of 10 m/pixel at appropriate solar elevation angles of less than 30°.

Scientific Objectives of Optical Observation: We, LISM working group, have four main scientific objectives of optical observation. They are to study:

(1) *Crustal composition and structure.* The compositional differences in highland crusts will be estimated by the observation of craters' central peaks, walls, rims and floors. It's a key to study how the crusts were made (ex. by magma-ocean, plutonic activities, etc.)

(2) *Mantle material.* Large impact craters such as South Pole Aitken may excavate material from mantle. By the observation of central peaks and floors of such craters, detailed mineral information such as Fe/Mg ratio of mantle material will be estimated.

(3) *Mare basalt volcanism.* By the observation of basalt layers, fresh craters and ejecta blocks, lunar thermal evolution such as melting depth and degrees of partial melting, vertical and horizontal diversity in the mantle source region, etc. will be estimated.

(4) *Tectonic activity of the moon.* There are many kinds of features as the results of tectonic activities on the lunar surface such as ridges, grabens, faults and so on. By the observation of them, lunar thermal history, lunar interior, mechanical properties of tectonic activities, etc. will be estimated.

Specifications of LISM (SP / MI / TC): We are proposing three optical instruments for SELENE mission to achieve all scientific objectives described above. The constraints of resources, such as mass or electric power, data transfer rate/time, mission life, controlled altitude, etc. are also taken into consideration. The main characteristics and detail specifications of instruments are described below and shown in Table 1, respectively.

1) Spectral Profiler (SP). Continuous spectra are useful to estimate detailed mineral information such as species, mixing ratio and so on. As for the moon, they have been obtained only from the Earth, so the observation targets of them were limited only for the nearside. SP obtains continuous spectra for both sides of the Moon with enough S/N ratios and accuracies to identify surface materials.

Table 1. Specifications of LISM on SELENE

	Spectral Profile	Multiband Imager	Terrain Camera
spectral-- range, resolution, bands	0.5–1.9 µm $\Delta\lambda$=10 nm 290 bands (5nm interval)	0.35–1.0 µm $\Delta\lambda$ = 10–30 nm 10 bands	0.4–0.7 µm $\Delta\lambda$ = 10–30 nm
swath /FOV	500 m/0.29°	17.5 km/10°	17.5 km/10°
spatial resolution/IFOV	500 m/0.29°	20 m/0.2 mrad	10 m/0.1mrad
MTF	N / A	0.2 @ Nyquist freq.	0.2 @ Nyquist freq.
spectrometers	dichroic mirror & grating 0.5–1.0 : Si-CCD 0.95–1.9 : InGaAs	bandpass filters on linear Si-CCD	bandpass filters on linear Si-CCD
signal to noise ratio (@solar elevation = 30)	300–1500	>100	100
quantization	16 bits	10 bits	10 bits
data rate	17 Kbps	6.6 Mbps	5.4 Mbps
other	onboard radiometric and spectral calibration	onboard radiometric calibration	two optical heads: B / H ratio = 0.6

2) Multi-band Imager (MI). Images of several spectral bands are useful for analysis such as discriminating surface geologic units. Though images provided by Clementine are for entire lunar surface in spatial resolution of about 200m, higher resolutions are required for our scientific objectives such as the study of mare basalt volcanism. MI obtains images of almost entire lunar surface with 10 spectral bands and high spatial resolution of 20m. When the data obtained by SP and MI are combined, detailed mineral distribution will be estimated for large area with high spatial resolution.

3) Terrain Camera (TC). By using the photo images, we can study the history of meteorite bombardments, the morphology of mountains, ridges, rills and so on. Though the Lunar Orbiters took images of almost entire lunar surface, most of them are in poor spatial resolution in the order of 100 m. In the Apollo missions, a lot of high-resolution images were taken, however, the areas of them are only on low latitude regions. As for Clementine, the solar elevation angles were too high to analyze the morphology of the moon. TC obtains the global digital stereo image data of entire lunar surface with high spatial resolution of 10 m/pixel at low solar elevation angle (less than 30°).

Conclusion: We have considered scientific objectives of optical observation and proposed three instruments for SELENE mission. SP and MI are useful to estimate the mineral distribution for the wide area of lunar surface with high spatial resolution. TC is useful to study details of lunar topography. We are planning to study more refined specification and start to develop the instruments from the next fiscal year.